

Amendment to the Claims:

The claims under examination in this application, including their current status and changes made in this paper, are respectfully presented.

Claims 1 through 17 are canceled.

18 (new). A method for transmitting a frame synchronization pattern utilizing a plurality of frequency tones, said method comprising:

- obtaining a frame synchronization pattern;
- grouping the pattern into pairs of binary values;
- assigning a first pair of binary values to at least one subcarrier;
- associating a second pair of binary values with a pilot tone and overwriting the second pair of binary values with values corresponding to a constant complex amplitude for the pilot tone;
- mapping each of a plurality of remaining pairs of binary values to a complex amplitude;
- assigning each of the mapped pairs to a corresponding one of the frequency tones;
- suppressing the amplitude of at least one of the frequency tones;
- then modulating at least a subset of the frequency tones in accordance with the mapped pairs corresponding thereto to produce modulated frame synchronization data; and
- transmitting the modulated frame synchronization data.

19 (new). A method as recited in claim 18, wherein the at least one subcarrier includes the d.c. and Nyquist subcarriers.

20 (new). A method as recited in claim 18, wherein the modulated frame synchronization data is a multicarrier symbol.

21 (new). A method as recited in claim 18, wherein the frame synchronization pattern is determined by the following equations:

$$x[p] = 1 \text{ for } p = 1 \text{ to } 9,$$

$$x[p] = x[p - 4] \oplus x[p - 9] \text{ for } p = 10 \text{ to } 512,$$

where $x[p]$ represents a binary value of the p^{th} value of the sequence, and \oplus represents modulo-2 addition.

22 (new). A method as recited in claim 21, wherein the modulated frame synchronization data comprises a sequence of time-domain samples;

and further comprising:

prior to the transmitting step, adding a cyclic prefix corresponding to a selected number of samples from the end of the sequence of time-domain samples.

23 (new). A method as recited in claim 18, further comprising:

allocating a bit loading for the plurality of frequency tones;

and wherein the suppressing step suppresses the amplitude of at least one of the plurality of frequency tones having a bit loading below a selected level.

24 (new). The method of claim 23, wherein the selected level is two bits.

25 (new). The method of claim 23, wherein the allocating of a bit loading for each frequency tone is based on a signal-to-noise ratio for the frequency tone.

26 (new). The method of claim 23, further comprising:

producing an energy scaling vector for the plurality of frequency tones from the bit loading;

wherein the suppressing step comprises:

for at least one of the plurality of frequency tones, multiplying the complex amplitude of the mapped pair of binary values by the energy scaling vector for that tone.

27 (new). The method of claim 23, further comprising a step of initializing communications with a receiver, prior to the allocating step, the initializing step comprising:

- obtaining the frame synchronization pattern;
- grouping the pattern into pairs of binary values;
- mapping each pair of the binary values to a complex amplitude;
- assigning each of the mapped pairs to a corresponding one of the frequency tones of the multicarrier modulation transmission system;
- modulating at least a subset of the frequency tones in accordance with the mapped pairs corresponding thereto to produce modulated frame synchronization data; and
- transmitting the modulated frame synchronization data to a receiver, so that the receiver can achieve frame synchronization with the transmitter.

28 (new). A method as recited in claim 18, further comprising:

- after the modulating and suppressing steps, converting the modulated frame synchronization data from digital data to analog signals at a selected sampling frequency;
- wherein the sampling frequency is an integral power of two times the frequency of the pilot tone.

29 (new). A method as recited in claim 18, wherein the transmitting step periodically transmits the modulated frame synchronization data among modulated data frames.

30 (new). A method as recited in claim 18, wherein the transmitting step transmits the modulated frame synchronization data over two-wire telephone subscriber line.

31 (new). A method as recited in claim 18, wherein the transmitting step transmits the modulated frame synchronization data in an asynchronous digital subscriber line system in an upstream direction of transmission.

32 (new). A method as recited in claim 18, wherein the transmitting step transmits the modulated frame synchronization data in an asynchronous digital subscriber line system in a downstream direction of transmission.

33 (new). A transmitter for communicating data using multicarrier modulation, said transmitter comprising:

- a frame synchronization sequence source for producing a sequence of binary values, wherein a first pair of the binary values is associated with d.c. and Nyquist subcarrier frequencies, and wherein each of a plurality of the remaining pairs of the binary values defines a complex amplitude for an associated frequency tone in a frequency domain synchronizing frame multicarrier symbol;

- circuitry for suppressing the complex amplitude of at least one of the frequency tones in the frequency domain synchronizing frame multicarrier symbol from that defined by its associated pair of binary values;

- a modulator, for producing a time domain multicarrier symbol from the frequency domain synchronizing frame multicarrier symbol; and

- a digital-to-analog converter for converting the time domain multicarrier symbol to an analog output signal.

34 (new). The transmitter of claim 33, wherein the suppressing circuitry comprises:

- a bit allocation table, for providing an energy scaling vector by which the complex amplitude for at least one of the frequency tones in the frequency domain synchronizing frame multicarrier symbol is multiplied prior to being applied to the modulator.

35 (new). The transmitter of claim 33, wherein the suppressing circuitry suppresses the complex amplitude of at least one of the frequency tones in the frequency domain synchronizing frame multicarrier symbol having a bit loading below a selected level.

36 (new). The transmitter of claim 33, further comprising:

- a coder for encoding a data stream into frequency domain multicarrier data symbols arranged in frames;

- wherein the modulator also produces time domain multicarrier data symbols from the frequency domain multicarrier data symbols;

- and wherein the digital-to-analog converter also converts the time domain multicarrier data symbols to an analog signal.

37 (new). The transmitter of claim 36, wherein the modulator periodically modulates the frequency domain synchronizing frame multicarrier symbol frequency domain multicarrier data symbols.

38 (new). The transmitter of claim 33, wherein the frame synchronization sequence source comprises circuitry for storing the frame synchronization pattern.

39 (new). The transmitter of claim 33, wherein the modulator comprises an inverse FFT unit.

40 (new). The transmitter of claim 33, wherein the sequence of binary values is determined by the following equations:

$$x[p] = 1 \text{ for } p = 1 \text{ to } 9,$$

$$x[p] = x[p - 4] \oplus x[p - 9] \text{ for } p = 10 \text{ to } 512,$$

where $x[p]$ represents a binary value of the p^{th} value of the sequence, and \oplus represents modulo-2 addition.

41 (new). The transmitter of claim 33, wherein the time domain multicarrier symbol comprises a sequence of time-domain samples;

and further comprising:

a cyclic prefix adder for adding a cyclic prefix corresponding to a selected number of samples from the end of the sequence of time-domain samples.

42 (new). The transmitter of claim 41, wherein the selected level is two bits.

43 (new). The transmitter of claim 33, wherein the digital-to-analog converter operates at a sampling frequency that is an integral power of two times the frequency of the pilot tone.

44 (new). The transmitter of claim 33, further comprising:

an analog-to-digital converter for converting a received analog signal to a serial time domain sample stream;

a demodulator for demodulating the time domain sample stream to a frequency domain multicarrier symbol; and
circuitry for recovering a decoded signal from the frequency domain multicarrier symbol.

45 (new). The transmitter of claim 44, further comprising:
a hybrid circuit, for coupling an input of the analog-to-digital converter and an output of the digital-to-analog converter to a transmission path.

46 (new). The transmitter of claim 45, wherein the transmission path comprises two-wire telephone subscriber line.

47 (new). The transmitter of claim 45, wherein the digital-to-analog converter operates at a first sampling frequency so that the output analog signal corresponds to a first rate of transmission;

and wherein the received analog signal corresponds to a second rate of transmission.

48 (new). The transmitter of claim 47, wherein the first rate of transmission is higher than the second rate of transmission.

49 (new). The transmitter of claim 47, wherein the first rate of transmission is lower than the second rate of transmission.

50 (new). The transmitter of claim 33, wherein a second pair of the binary values is associated with a pilot frequency tone and is overwritten with a constant complex amplitude for the pilot frequency tone.

51 (new). A method for transmitting a frame synchronization pattern utilizing a plurality of frequency tones, said method comprising:

obtaining a frame synchronization pattern;

grouping the pattern into pairs of binary values;

assigning a first pair of binary values to d.c. and Nyquist subcarriers;

mapping each of a plurality of remaining pairs of binary values to a complex amplitude;
assigning each of the mapped pairs to a corresponding one of the frequency tones;
suppressing the amplitude of at least one of the frequency tones;
then modulating at least a subset of the frequency tones in accordance with the mapped pairs corresponding thereto to produce modulated frame synchronization data; and
transmitting the modulated frame synchronization data.

52 (new). A method as recited in claim 51, wherein the frame synchronization pattern is determined by the following equations:

$$x[p] = 1 \text{ for } p = 1 \text{ to } 9,$$

$$x[p] = x[p - 4] \oplus x[p - 9] \text{ for } p = 10 \text{ to } 512,$$

where $x[p]$ represents a binary value of the p^{th} value of the sequence, and \oplus represents modulo-2 addition.

53 (new). A method as recited in claim 51, wherein the modulated frame synchronization data comprises a sequence of time-domain samples;

and further comprising:

prior to the transmitting step, adding a cyclic prefix corresponding to a selected number of samples from the end of the sequence of time-domain samples.

54 (new). A method as recited in claim 51, further comprising:

allocating a bit loading for the plurality of frequency tones;

and wherein the suppressing step suppresses the amplitude of at least one of the plurality of frequency tones having a bit loading below a selected level.

55 (new). The method of claim 54, wherein the selected level is two bits.

56 (new). The method of claim 54, wherein the allocating of a bit loading for each frequency tone is based on a signal-to-noise ratio for the frequency tone.

57 (new). The method of claim 54, further comprising:
producing an energy scaling vector for the plurality of frequency tones from the bit loading;

wherein the suppressing step comprises:
for at least one of the plurality of frequency tones, multiplying the complex amplitude of the mapped pair of binary values by the energy scaling vector for that tone.

58 (new). A method as recited in claim 51, wherein the transmitting step periodically transmits the modulated frame synchronization data among modulated data frames.

59 (new). A method as recited in claim 51, wherein the transmitting step transmits the modulated frame synchronization data over two-wire telephone subscriber line.

60 (new). A method as recited in claim 51, wherein the transmitting step transmits the modulated frame synchronization data in an asynchronous digital subscriber line system in an upstream direction of transmission.

61 (new). A method as recited in claim 51, wherein the transmitting step transmits the modulated frame synchronization data in an asynchronous digital subscriber line system in a downstream direction of transmission.

62 (new). A method as recited in claim 51, further comprising:
associating a second pair of binary values with a pilot tone and overwriting the second pair of binary values with values corresponding to a constant complex amplitude for the pilot tone.